Claims

We Claim:

1) A melt spinnable composition useful in preparing textile fibers comprising a high molecular weight polyurethane polymer prepared from at least one diisocyanate monomer and at least two diol monomers, a first diol monomer of relatively high molecular weight and a second diol monomer of low molecular weight, said polyurethane having a molecular weight above about 200,000, a tenacity above about 0.6 gm/denier, and an elongation above about 400%, wherein said first and second diol monomers are always reacted separately during preparation of the polyurethane polymer.

2) A composition according to claim 1 wherein the second low molecular weight diol has a molecular weight of about 62 to about 118.

3) A compostion according to claim 1 wherein the first relatively high molecular weight diol has a molecular weight of about 1000 to about 8000.

4) A composition according to claim 1 wherein the first diol monomer is a member selected from the group consisting of a polyether diol, a polyester diol and a mixed polyether-polyester diol.

5) A composition according to claim 1 wherein the at least one diisocyanate monomer is a member selected from the group consisting of aliphatic monomers having terminal isocyanate groups, aromatic monomers having terminal isocyanate groups, mixtures of said aliphatic and aromatic monomers and isomeric mixtures of said aliphatic or aromatic monomers.

6) A composition according to claim 5 wherein the at least one diisocyanate monomer is a member selected from the group consisting of 1, 6-hexane diisocyanate, toluene diisocyanate isomers and methylene bis (phenylisocyanate) isomers.

7) A composition according to claim 1 wherein the high molecular weight polyurethane polymer contains "hard" segments and "soft" segments, said segments arranged in an orderly, non-random fashion to obtain discrete distances between urethane groups.

8) A composition according to claim 1 wherein the high molecular weight polyurethane polymer contains a small amount of urea groups wherein said urea groups are obtained by post-treatment of the polyurethane polymer with a low molecular weight diamine.

9) A composition according to claim 8 wherein the low molecular weight diamine comprises ethylene diamine.

10) A process of preparing a polyurethane polymer fiber precursor, the process comprising the steps of:

a) obtaining a polyol prepolymer which is a member selected from the group consisting of hydroxyl terminated polyester glycols, hydroxyl terminated polyether/polyester glycols, and mixtures thereof;

b) adding a first organic diisocyanate to the polyol prepolymer wherein the mole ratio of diisocyanate to prepolymer is about 1.2 to 1:1.1 to obtain a first mixture;

c) reacting the first mixture of first organic diisocyanate and polyol prepolymer at a temperature of about 60°C to about 100°C and at atmospheric pressure for a time of about 20 minutes to about 100 minutes to obtain a first "soft" polymer having a viscosity of about 50-800 poises;

d) obtaining a low molecular weight glycol having terminal hydroxyl groups;

e) adding a second organic diisocyanate to the glycol wherein the mole ratio of isocyanate to hydroxyl is about 1.2 to about 1:1.2 to obtain a second mixture;

f) reacting the second mixture of second organic diisocyanate and low molecular weight glycol at a temperature of about 50°C to about 70°C and at atmospheric pressure for a time of about 2 minutes to about 10 minutes to obtain a second "hard" polymer;

g) combining the first "soft" polymer from (c) with the second "hard" polymer from (f) in an extruder to obtain a combination of polymers wherein the mole ratio of isocyanate functionality to hydroxyl functionality in the combination is about 0.98:1 to about 1.2:1;

h) reacting the combination of polymers in the extruder under polymerization and high mixing

conditions and at a temperature of about 125°C to about 260°C for a time of about 2 minutes to about 8 minutes and at atmospheric pressure to obtain a final polyurethane polymer; and

j) extruding the final polyurethane polymer to obtain a solid product of polyurethane polymer fiber precursor.

11) A process according to claim 10 further comprising the steps of:

k) pelletizing the solid product of polyurethane polymer fiber precursor;

l) melting the pelletized solid product; and

m) spinning the melted product to obtain a Spandex-like polyurethane polymer fiber.

12) A Spandex-like polyurethane polymer fiber prepared according to the process of claim 11.

13) A process according to claim 10 further comprising the steps of:

(k') pelletizing the solid product of polyurethane polymer fiber precursor;

(l') melting the pelletized solid product; and

(m') spinning the melted product in the presence of a low molecular weight aliphatic diamine vapor to obtain a Spandex-like polyurethane polymer fiber having a minor amount of urea functionality.

14) A Spandex-like polyurethane polymer fiber having a minor amount of urea functionality prepared according to the process of claim 13.

15) A process according to claim 10 further comprising the steps of:

(k") pelletizing the solid product of polyurethane polymer fiber precusor;

(l") melting the pelletized solid product; and

(m") spinning the melted product into an aqueous solution of low molecular weight aliphatic diamine to obtain a Spandex-like polyurethane polymer fiber having a minor amount of urea functionality.

16) A Spandex-like polyurethane polymer fiber having a minor amount of urea functionality prepared according to the process of claim 15.

17) A process according to claim 10 wherein the polyol prepolymer of step (a) is a liquid under standard conditions of temperature and pressure.

18) A process according to claim 10 wherein the first organic diisocyanate of step (b) and the second diisocyanate of step (e) are each a member selected from the group consisting of 1, 6-hexane diisocyanate, toluene diisocyanate isomers, and methylene bis (phenylisocyanate) isomers.

19) A process according to claim 10 wherein step (h) is conducted in the presence of a catalyst.

20) A process for preparing a polyurethane polymer fiber precursor, the process comprising the steps of:

(a) obtaining a polyol prepolymer which is a member selected from the group consisting of hydroxyl terminated polyester glycols, hydroxyl terminated polyether/polyester glycols, and mixtures thereof;

(b) adding an organic diisocyanate to the polyol prepolymer wherein the mole ratio of isocyanate to hydroxyl is about 1:2 to about 1:1.1 to obtain a first mixture;

(c) reacting a first mixture of organic diisocyanate and polyol prepolymer at a temperature of about 60°C to about 100°C and at atmospheric pressure for a time of about 20 minutes to about 100 minutes to obtain a first "soft" polymer and unreacted diisocyanate;

(d) obtaining a low molecular weight glycol having terminal hydroxyl groups;

(e) adding the first polymer and the unreacted diisocyanate from step (c) to the low molecular weight glycol in a reaction extruder to obtain a second mixture wherein the mole ratio of isocyanate group to hydroxyl group approaches 1.000;

(f) reacting the second mixture of first "soft" polymer, unreacted diisocyanate and low molecular weight glycol in a reaction extruder under polymerization and high mixing

conditions and at a temperature of about 125°C to about 260°C for a time of about 2 minutes to about 8 minutes and at atmospheric pressure to obtain a final polyurethane polymer; and

(g) extruding the final polyurethane polymer to obtain a solid product of polyurethane polymer fiber precursor.

21) A process according to claim 20 further comprising the steps of:

(h) pelletizing the solid product of polyurethane polymer fiber precursor;

(j) melting the pelletized solid product; and

(k) spinning the melted product to obtain a Spandex-like polyurethane polymer fiber.

22) A Spandex-like polyurethane polymer fiber prepared according to the process of claim 21.

23) A process according to claim 20 further comprising the steps of:

(h') pelletizing the solid product of polyurethane polymer fiber precursor;

(j') melting the pelletized solid product; and

(k')spinning the melted product in the presence of a low molecular weight aliphatic diamine vapor to obtain a Spandex-like polyurethane polymer fiber having a minor amount of urea functionality.

24) A Spandex-like polyurethane polymer fiber having a minor amount of urea functionality prepared according to the process of claim 23.

25) A process according to claim 20 further comprising the steps of:

(h")pelletizing the solid product of polyurethane polymer fiber precursor;

(j")melting the pelletized solid product; and

(k")spinning the melted product into an aqueous solution of low molecular weight aliphatic diamine to obtain a Spandex-like polyurethane polymer fiber having a minor amount of urea functionality.

26) A spandex-like polyurethane polymer fiber having a minor amount of urea functionality prepared according to the process of 25.

27) A process according to claim 20 wherein the organic diisocyanate of step (b) is a liquid under standard conditions of temperature and pressure.

28) A process according to claim 20 wherein the organic diisocyanate of step (b) is a member selected from the group consisting of 1, 6-hexane diisocyanate, toluene diisocyanate isomers, and methylene bis (phenylisocyanate) isomers.

29) A process according to claim 20 wherein step (f) is conducted in the presence of a catalyst.